# Exercise 16

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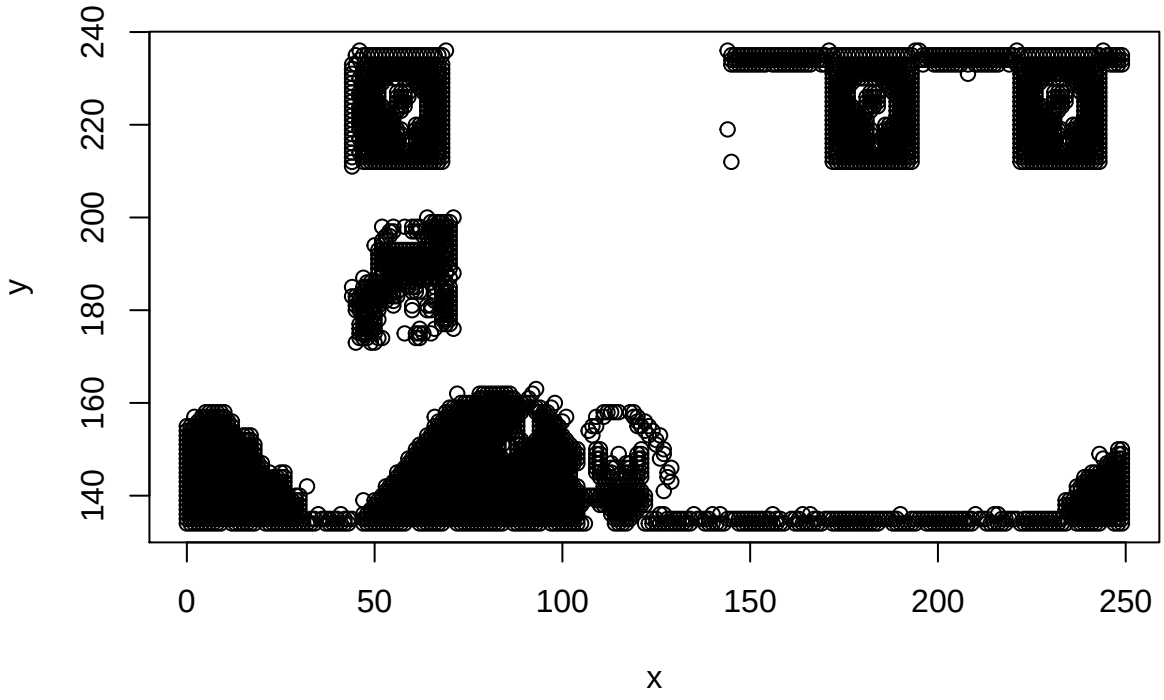
2/12/2021

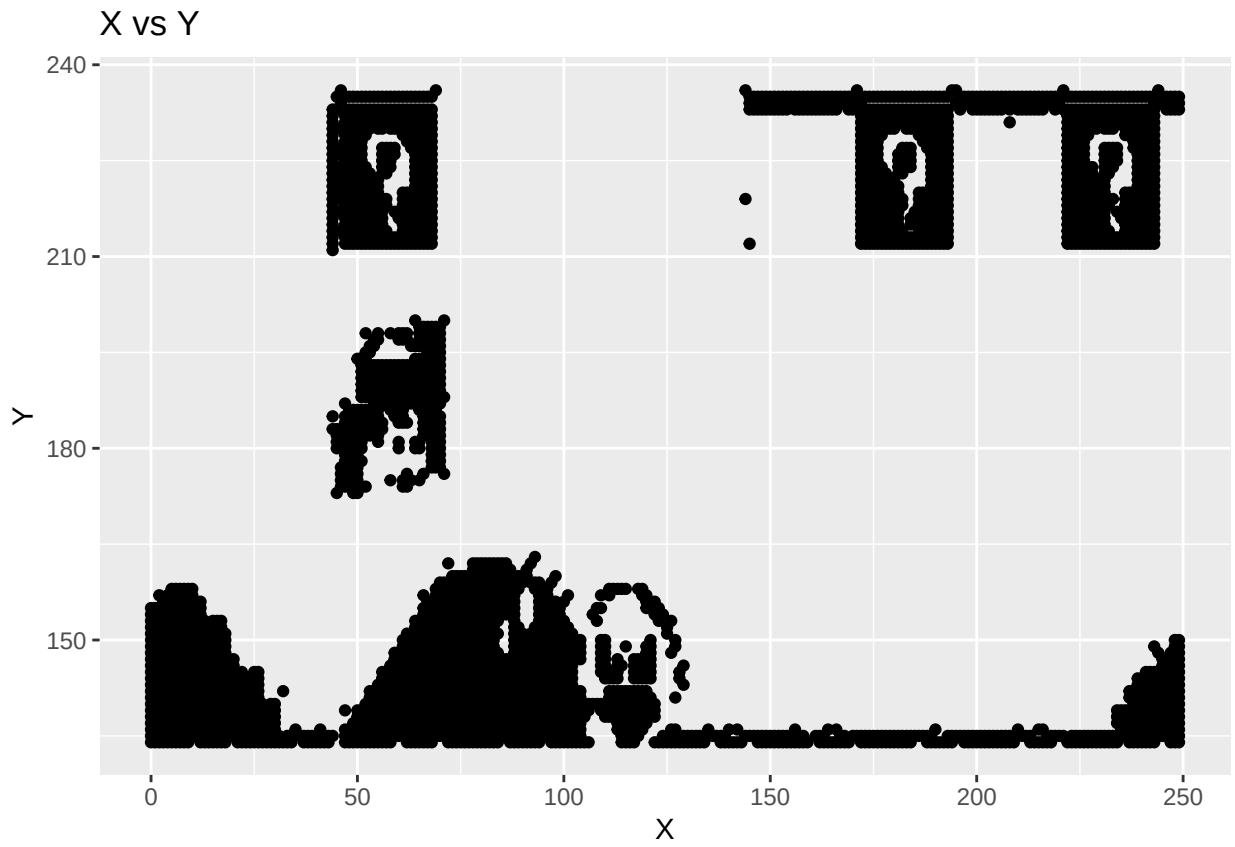
## Clustering

## A. Plot the dataset using a scatter plot.

```
plot(datasetcluster_df)
```

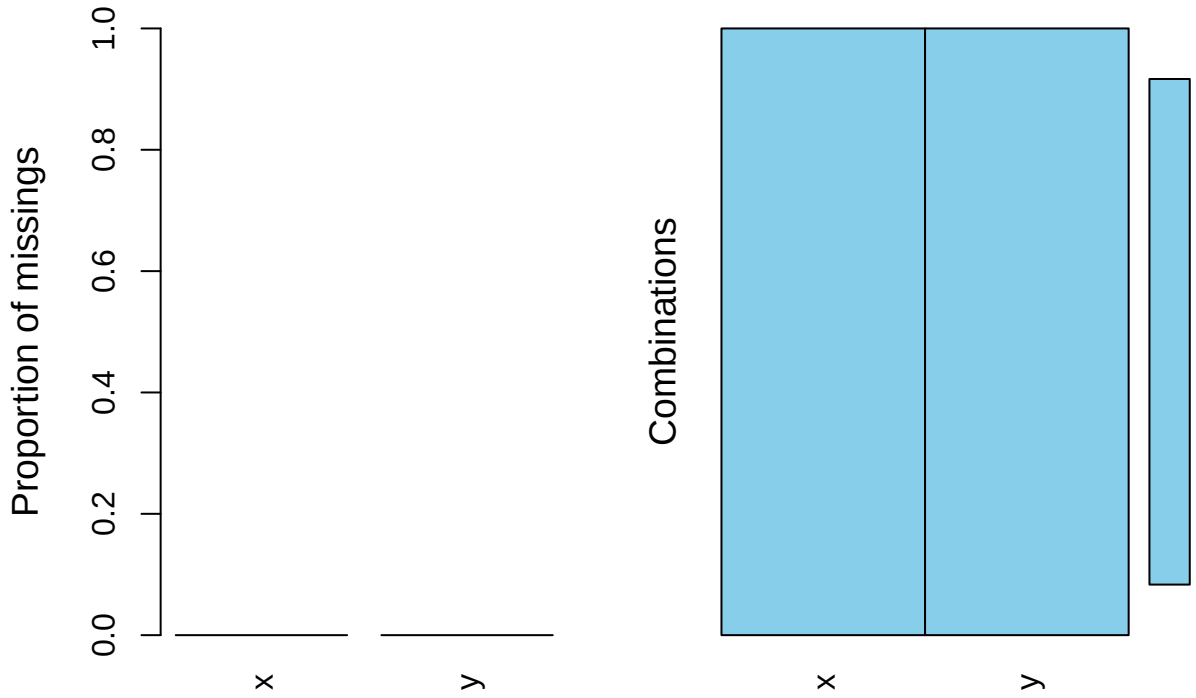



```
ggplot(datasetcluster_df, aes(x= x, y= y)) + geom_point( )+
  labs(title= "X vs Y", x="X", y="Y")
```




**B. Fit the dataset using the k-means algorithm from k=2 to k=12. Create a scatter plot of the resultant clusters for each value of k.**

```
aggr(datasetcluster_df)
```




```
cluster2 <- kmeans(datasetcluster_df[, 1:2], 2)
cluster2
```

```
## K-means clustering with 2 clusters of sizes 2714, 1308
##
## Cluster means:
##          x        y
## 1  62.2815 162.4090
## 2 207.8005 203.2898
##
## Clustering vector:
##    [1] 1 1 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2
##   [38] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
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## [3997] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
##
## Within cluster sum of squares by cluster:
## [1] 5385717 3057964
##  (between_SS / total_SS =  70.5 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
cluster3 <- kmeans(datasetcluster_df[, 1:2],3 )
cluster3
```

```
## K-means clustering with 3 clusters of sizes 1292, 2125, 605
```

```
##
## Cluster means:
##           x        y
## 1 208.48529 204.1409
## 2  76.33694 167.7765
## 3  15.29917 142.8198
##
## Clustering vector:
##    [1] 2 2 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1
##   [38] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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## [3997] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##
## Within cluster sum of squares by cluster:
## [1] 2931827.1 3354777.6  125040.2
##  (between_SS / total_SS =  77.6 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
cluster4 <- kmeans(datasetcluster_df[, 1:2],4 )
cluster4
```

```
## K-means clustering with 4 clusters of sizes 1272, 1376, 782, 592
##
## Cluster means:
##           x        y
## 1 209.19733 205.2351
## 2  88.12209 144.5305
## 3  57.42711 207.3043
## 4  14.47973 142.9662
##
## Clustering vector:
##    [1] 3 3 1 1 1 1 1 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 1 1 1 1 1
##   [38] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [75] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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## [3997] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##
## Within cluster sum of squares by cluster:
## [1] 2791492.2  778264.2  334024.9  105897.1
##  (between_SS / total_SS =  86.0 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
cluster5 <- kmeans(datasetcluster_df[, 1:2],5 )
cluster5
```

```
## K-means clustering with 5 clusters of sizes 985, 586, 313, 782, 1356
##
## Cluster means:
##           x        y
## 1 203.98579 224.8406
## 2  14.10580 143.0324
## 3 221.61981 137.6677
## 4  57.42711 207.3043
```

```
## 5  86.55457 144.6858
##
## Clustering vector:
##    [1] 4 4 1 1 1 1 1 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 1 1 1 1 1 1
##   [38] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [75] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [112] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [149] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [186] 1 1 1 1 1 1 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 1 1 1 1 1 1 1
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##
## Within cluster sum of squares by cluster:
## [1] 831375.78  97541.82 267545.20 334024.91 641125.13
##  (between_SS / total_SS =  92.4 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
cluster6 <- kmeans(datasetcluster_df[, 1:2],6 )
cluster6
```

```
## K-means clustering with 6 clusters of sizes 930, 771, 985, 480, 287, 569
##
## Cluster means:
##           x        y
## 1  74.28817 145.8355
## 2  57.31518 207.7575
## 3 203.98579 224.8406
## 4 112.54167 142.3063
## 5 227.08362 137.9477
## 6  13.07206 143.2460
##
## Clustering vector:
##    [1] 2 2 3 3 3 3 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3
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## [3997] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##
## Within cluster sum of squares by cluster:
## [1] 185246.6 321932.1 831375.8 177747.1 163518.2  75619.6
##  (between_SS / total_SS =  93.9 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
cluster7 <- kmeans(datasetcluster_df[, 1:2],7 )
cluster7
```

```
## K-means clustering with 7 clusters of sizes 480, 771, 518, 569, 467, 930, 287
##
## Cluster means:
##           x        y
## 1 112.54167 142.3063
## 2  57.31518 207.7575
## 3 179.55019 225.2664
## 4  13.07206 143.2460
## 5 231.08994 224.3683
## 6  74.28817 145.8355
## 7 227.08362 137.9477
```

```
##
## Clustering vector:
##    [1] 2 2 3 3 3 3 5 5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3
##   [38] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
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## [3997] 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
##
## Within cluster sum of squares by cluster:
## [1] 177747.15 321932.06 112959.43  75619.60  65846.87 185246.60 163518.21
##  (between_SS / total_SS =  96.1 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
cluster8 <- kmeans(datasetcluster_df[, 1:2],8 )
cluster8
```

```
## K-means clustering with 8 clusters of sizes 439, 569, 462, 287, 771, 84, 930, 480
##
## Cluster means:
##           x        y
## 1 184.00683 223.7677
## 2  13.07206 143.2460
## 3 231.35714 224.2619
## 4 227.08362 137.9477
## 5  57.31518 207.7575
## 6 157.85714 233.6310
## 7  74.28817 145.8355
## 8 112.54167 142.3063
##
## Clustering vector:
##    [1] 5 5 6 6 1 1 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 6 6 6 6 6
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##
## Within cluster sum of squares by cluster:
## [1]  55139.280  75619.599  62273.381 163518.209 321932.057   6715.845 185246.599
## [8] 177747.148
##  (between_SS / total_SS =  96.3 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
cluster9 <- kmeans(datasetcluster_df[, 1:2],9 )
cluster9
```

```
## K-means clustering with 9 clusters of sizes 216, 341, 560, 107, 525, 985, 232, 441, 615
##
## Cluster means:
##           x        y
## 1 239.28704 139.0648
## 2  58.82698 186.9824
## 3  12.61071 143.3839
## 4 179.35514 134.5514
## 5  65.81143 143.4457
```

```
## 6 203.98579 224.8406
## 7 118.62931 141.4440
## 8  56.34467 223.0181
## 9  89.41301 146.7431
##
## Clustering vector:
##    [1] 8 8 6 6 6 6 6 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 6 6 6 6 6 6
##   [38] 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
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## [3775] 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [3812] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
## [3849] 3 3 3 3 3 3 3 3 3 3 3 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
## [3886] 5 5 5 5 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 7 7 7 7 7 7 7 7 7 7 7
## [3923] 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
## [3960] 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 1 1 1
## [3997] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##
## Within cluster sum of squares by cluster:
## [1]  22577.30  35774.69  67391.59  34946.97  61054.03 831375.78  33365.39
## [8]  47345.46  73370.50
##  (between_SS / total_SS =  95.8 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
cluster10 <- kmeans(datasetcluster_df[, 1:2],10)
cluster10
```

```
## K-means clustering with 10 clusters of sizes 204, 230, 600, 107, 985, 196, 216, 169, 760, 555
##
## Cluster means:
##             x        y
## 1    8.372549 150.8382
## 2  118.765217 141.4783
## 3   89.816667 146.4567
## 4  179.355140 134.5514
## 5  203.985787 224.8406
## 6    7.806122 139.3878
## 7  239.287037 139.0648
## 8   24.852071 138.5562
## 9   57.410526 208.2447
## 10  66.227027 145.2090
##
## Clustering vector:
##    [1]  9  9  5  5  5  5  5  5  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##   [25]  9  9  9  9  9  9  9  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##   [49]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##   [73]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##   [97]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [121]  5  5  5  5  5  5  5  5  5  5  5  5  9  5  5  5  5  5  5  5  5  5  5  5
##  [145]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [169]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [193]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  5
##  [217]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [241]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [265]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [289]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  9  9  9  9  9  9  9
##  [313]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  5  5  5  5  5  5  5
##  [337]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [361]  5  5  5  5  5  5  5  5  5  5  5  5  5  9  9  9  9  9  9  9  9  9  9  9
##  [385]  9  9  9  9  9  9  9  9  9  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
```

```
##  [409] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##  [433] 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
##  [457] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##  [481] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 9 9 9 9 9 9 9 9
##  [505] 9 9 9 9 9 9 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##  [529] 5 5 5 5 5 5 5 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 5
##  [553] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 9 9
##  [577] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5 5 5
##  [601] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 9 9 9 9
##  [625] 9 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5 5 5 5 5 5
##  [649] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 9 9 9 9 9 9 9
##  [673] 9 9 9 9 9 9 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##  [697] 5 5 5 5 5 5 5 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9
##  [721] 9 9 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##  [745] 5 5 5 5 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
##  [769] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##  [793] 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5
##  [817] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##  [841] 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5
##  [865] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 9
##  [889] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5
##  [913] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##  [937] 5 5 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
##  [961] 9 9 9 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
##  [985] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 9 9 9 9 9
## [1009] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5 5 5
## [1033] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
## [1057] 5 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
## [1081] 9 9 9 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
## [1105] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 9 9 9 9 9
## [1129] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5 5 5 5 5
## [1153] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
## [1177] 5 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
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## [1225] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9
## [1249] 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
## [1273] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 9 9 9 9 9
## [1297] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5
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## [1369] 9 9 9 9 9 9 9 9 9 9 9 9 9 5 5 5 5 5 5 5 5 5 5 5 5 5
## [1393] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
## [1417] 5 5 5 5 5 5 5 5 5 5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
## [1441] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
## [1465] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
## [1489] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
## [1513] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
## [1537] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
## [1561] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
## [1585] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
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## [1657] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
## [1681] 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
```

```
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## [1753] 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10  3 10  3  3  3  3  3  3
## [1777]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3 10 10 10 10 10  3  3  3  3  3
## [1801]  3  3  3  3  3  3  3  3  3  3 10 10 10 10 10 10 10 10  3  3  3  3  3  3
## [1825]  3  3  3  3  3  3  3  3  3  3  3  1  1  1  1  1  1 10 10 10 10 10 10 10
## [1849] 10 10  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  2  2  2  2  2  2
## [1873]  2  1  1  1  1  1  1  1  1 10 10 10 10 10 10 10 10 10 10 10  3  3  3  3  3
## [1897]  3  3  3  3  3  3  3  3  3  3  2  2  2  2  1  1  1  1  1  1  1  1  1  1
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## [1969] 10 10 10 10 10 10 10  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
## [1993]  2  2  2  2  2  1  1  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10 10 10 10
## [2017] 10 10 10 10 10 10  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  2
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## [2065] 10 10 10 10 10 10 10 10 10  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
## [2089]  2  2  2  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10
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## [2233] 10 10  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
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## [2521] 10 10 10  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
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## [2569]  6  6  6  1  1  1  1  1  1  8  8  8  8  8  8  8 10 10 10 10 10 10 10 10
## [2593] 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10  3  3  3  3  3  3  3  3  3
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## [2665]  6  6  6  6  8  8  8  8  8  8  8  8  8  8 10 10 10 10 10 10 10 10 10 10 10
## [2689] 10 10 10 10 10 10 10 10 10 10 10 10 10  3  3  3  3  3  3  3  3  3  3  3  3
## [2713]  3  3  3  3  3  3  3  3  3  3  3  3  3  2  2  2  2  2  2  2  2  2  2  7  7
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## [2761]  6  6  8  8  8  8  8  8  8  8  8  8 10 10 10 10 10 10 10 10 10 10 10 10 10
## [2785] 10 10 10 10 10 10 10 10 10 10 10 10  3  3  3  3  3  3  3  3  3  3  3  3  3
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## [2857]  8  8  8 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
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## [2977] 10 10 10 10 10 10 10 10 10 10 10 10  3  3  3  3  3  3  3  3  3  3  3  3  3
```

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## [3073] 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10  3
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## [3313] 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10  3  3  3  3  3
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## [3673] 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10  3
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## [3769]  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4
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## [3841]  6  6  6  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [3865]  8  8 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
## [3889] 10 10 10 10  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
## [3913]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3937]  2  2  2  2  2  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4
## [3961]  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4
## [3985]  4  4  4  4  4  4  4  4  4  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
## [4009]  7  7  7  7  7  7  7  7  7  7  7  7  7  7
##
## Within cluster sum of squares by cluster:
##  [1]   7663.348  32840.713  69902.707  34946.972 831375.777   6863.163
##  [7]  22577.296   9307.018 308528.395  82293.150
##  (between_SS / total_SS =  95.1 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```r
cluster11 <- kmeans(datasetcluster_df[, 1:2],11 )
cluster11
```

```
## K-means clustering with 11 clusters of sizes 406, 553, 441, 307, 104, 467, 518, 341, 215, 209, 461
##
## Cluster means:
##            x        y
## 1   94.91133 143.7931
## 2   12.29295 143.4955
## 3   56.34467 223.0181
## 4   60.12052 139.9218
## 5  180.79808 134.5673
## 6  231.08994 224.3683
## 7  179.55019 225.2664
## 8   58.82698 186.9824
## 9  239.42326 139.0791
## 10 120.97129 141.4019
## 11  77.33189 149.5922
##
## Clustering vector:
##    [1]  3  3  7  7  7  7  6  6  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
##   [25]  3  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
##   [49]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
##   [73]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6
##   [97]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [121]  6  6  6  6  6  6  6  6  6  6  6  6  3  7  7  7  7  7  7  7  7  7  7  7  7
##  [145]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
##  [169]  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [193]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  7
##  [217]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
##  [241]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
##  [265]  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [289]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3
##  [313]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7  7
##  [337]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6
##  [361]  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3  3  3  3
##  [385]  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
##  [409]  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [433]  6  6  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
##  [457]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6
##  [481]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3
##  [505]  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6
##  [529]  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3  3  3  3  3  7
##  [553]  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  3  3
##  [577]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7
##  [601]  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3
##  [625]  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7  7  7  7
##  [649]  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3
##  [673]  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6
##  [697]  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
##  [721]  3  3  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6
##  [745]  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
##  [769]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6
```

```
##  [793]  6  6  6  6  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7
##  [817]  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [841]  6  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7
##  [865]  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3
##  [889]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7
##  [913]  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  6
##  [937]  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
##  [961]  3  3  3  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6
##  [985]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3
## [1009]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7
## [1033]  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6
## [1057]  6  6  6  6  6  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
## [1081]  3  3  3  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6
## [1105]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3
## [1129]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7  7
## [1153]  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6
## [1177]  6  6  6  6  6  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
## [1201]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6
## [1225]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3  3
## [1249]  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
## [1273]  7  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3
## [1297]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7
## [1321]  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6
## [1345]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  3  3  3  3  3  3  3  3  3  3
## [1369]  3  3  3  3  3  3  3  3  3  3  3  3  3  7  7  7  7  7  7  7  7  7  7  7  7
## [1393]  7  7  7  7  7  7  7  7  7  7  7  7  6  6  6  6  6  6  6  6  6  6  6  6  6
## [1417]  6  6  6  6  6  6  6  6  6  3  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1441]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1465]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1489]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1513]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1537]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1561]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1585]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1609]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1633]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1657]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1681]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1705]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1729]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [1753]  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  1 11 11 11 11 11 11 11 11
## [1777] 11 11  1 11 11 11 11 11 11 11 11 11 11 11  1 11 11 11 11 11 11 11 11 11 11
## [1801] 11 11 11 11 11 11 11 11  1  1 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [1825] 11 11 11 11 11 11 11  1  1  1  1  2  2  2  2  2  2 11 11 11 11 11 11 11 11
## [1849] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1  1  1  1 10 10 10 10 10 10
## [1873] 10  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [1897] 11 11 11 11 11 11  1  1  1  1  1 10 10 10  2  2  2  2  2  2  2  2  2  2  2
## [1921] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1  1
## [1945]  1  1  1  1 10 10  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11
## [1969] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1  1  1  1  1  1
## [1993]  1  1 10 10 10  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11
## [2017] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1  1  1  1  1  1
## [2041] 10 10  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  4 11 11 11 11
## [2065] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1  1  1  1  1  1
```

```
## [2089]  1 10 10  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  4 11 11
## [2113] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1  1  1  1  1  1
## [2137]  1  1  1  1 10  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2161]  4  4  4  4 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2185]  1  1  1  1  1  1  1  1  1  1  1  1  1 10  2  2  2  2  2  2  2  2  2  2
## [2209]  2  2  2  2  2  2  2  2  2  4  4  4  4  4 11 11 11 11 11 11 11 11 11 11
## [2233] 11 11 11 11 11 11 11 11  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
## [2257]  1 10 10 10 10  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2281]  2  2  4  4  4  4  4  4 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2305] 11  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10 10 10
## [2329]  9  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  4  4
## [2353]  4  4  4  4  4  4 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2377]  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10 10 10  9
## [2401]  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  4
## [2425]  4  4  4  4  4  4  4  4 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2449] 11 11 11  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 10 10
## [2473] 10 10 10 10  9  9  9  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2497]  2  2  2  2  2  2  4  4  4  4  4  4  4  4  4  4  4  4 11 11 11 11 11 11
## [2521] 11 11 11 11 11 11 11 11 11 11 11  1  1  1  1  1  1  1  1  1  1  1  1  1
## [2545]  1  1  1 10 10 10 10 10 10 10 10  9  9  9  9  9  2  2  2  2  2  2  2  2
## [2569]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  4  4  4  4  4  4  4  4
## [2593]  4  4  4  4  4 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1
## [2617]  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10 10 10 10 10 10 10
## [2641] 10 10  9  9  9  9  9  9  9  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2665]  2  2  2  2  2  2  2  2  2  2  2  2  2  4  4  4  4  4  4  4  4  4  4  4
## [2689]  4  4  4 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1  1  1
## [2713]  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10 10 10 10 10 10 10 10  9  9
## [2737]  9  9  9  9  9  9  9  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2761]  2  2  2  2  2  2  2  2  2  2  2  4  4  4  4  4  4  4  4  4  4  4  4  4
## [2785]  4  4 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1  1  1  1  1
## [2809]  1  1  1  1  1  1  1  1  1  1  1 10  9  9  9  9  9  9  9  9  9  9  9  2
## [2833]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2857]  2  2  2  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4 11 11
## [2881] 11 11 11 11 11 11 11 11 11 11 11 11  1  1  1  1  1  1  1  1  1  1  1  1
## [2905]  1  1  1  1  1  1  1 10 10 10 10 10 10 10 10 10 10  9  9  9  9  9  9  9
## [2929]  9  9  9  9  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2953]  2  2  2  2  2  2  2  2  2  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4
## [2977]  4  4  4 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  1  1  1  1  1
## [3001]  1  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10 10 10 10 10 10 10 10 10
## [3025] 10  9  9  9  9  9  9  9  9  9  9  9  9  9  2  2  2  2  2  2  2  2  2  2
## [3049]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  4  4  4  4
## [3073]  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4 11 11 11 11 11 11 11 11 11
## [3097] 11 11 11 11  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
## [3121]  1  1  1  1 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10  9  9  9
## [3145]  9  9  9  9  9  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3169]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  4  4  4  4  4  4  4  4  4  4
## [3193]  4  4  4  4  4  4  4  4  4  4  4  4  4  4 11 11 11 11 11 11 11 11 11 11
## [3217] 11  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
## [3241] 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10  9  9  9  9  9  9  9  9  9
## [3265]  9  9  9  9  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3289]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  4  4  4  4  4  4  4  4  4  4
## [3313]  4  4  4  4  4  4  4  4  4  4  4  4  4 11 11 11 11 11 11 11 11 11 11 11
## [3337]  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10
## [3361] 10 10 10 10 10 10 10 10 10 10 10  9  9  9  9  9  9  9  9  9  9  9  9  9
```

```
## [3385]  9  9  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3409]  2  2  2  2  2  2  2  2  2  4  4  4  4  4  4  4  4  4  4  4  4  4  4
## [3433]  4  4  4  4  4  4  4  4  4  4 11 11 11 11 11 11 11 11 11  1  1  1  1  1
## [3457]  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10 10 10 10 10
## [3481] 10  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  2  2  2  2  2  2  2
## [3505]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3529]  2  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4
## [3553]  4  4  4  4  4 11 11 11 11 11 11 11 11 11  1  1  1  1  1  1  1  1  1  1
## [3577]  1  1  1  1  1  1  1  1  1  1  1  1 10 10 10 10 10 10 10 10 10 10 10 10
## [3601]  5  5  5  5  5  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  2  2
## [3625]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3649]  2  2  2  2  2  2  2  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4
## [3673]  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4 11 11 11 11 11
## [3697] 11 11 11  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
## [3721]  1 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
## [3745] 10 10  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
## [3769]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
## [3793]  5  5  5  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
## [3817]  9  9  9  9  9  9  9  9  9  9  9  9  2  2  2  2  2  2  2  2  2  2  2  2
## [3841]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  4  4  4  4  4
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## [3889] 11 11 11 11 11 11 11  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
## [3913]  1  1  1  1 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
## [3937] 10 10 10 10 10 10 10  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
## [3961]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
## [3985]  5  5  5  5  5  5  5  5  5  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
## [4009]  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##
## Within cluster sum of squares by cluster:
##  [1]  32021.43  62364.78  47345.46  24864.66  32104.29  65846.87 112959.43
##  [8]  35774.69  21706.14  29808.07  39943.55
##  (between_SS / total_SS =  98.2 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
cluster12 <- kmeans(datasetcluster_df[, 1:2],12 )
cluster12
```

```
## K-means clustering with 12 clusters of sizes 105, 521, 341, 95, 233, 107, 101, 218, 985, 140, 616, 5
##
## Cluster means:
##            x        y
## 1   63.12381 229.8000
## 2   65.72169 143.4299
## 3   58.82698 186.9824
## 4   64.22105 216.7684
## 5  118.17167 141.4549
## 6  178.21495 134.5514
## 7   49.79208 229.6634
## 8  239.00917 139.0229
## 9  203.98579 224.8406
```

```
## 10  50.64286 217.3786
## 11  89.27110 146.7792
## 12  12.61071 143.3839
##
## Clustering vector:
##    [1]  7  1  9  9  9  9  9  9  7  7  7  7  7  7  7  7  7  7  7  1  1  1  1  1
##   [25]  1  1  1  1  1  1  1  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##   [49]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##   [73]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##   [97]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [121]  9  9  9  9  9  9  9  9  9  9  9  9  7  9  9  9  9  9  9  9  9  9  9  9
##  [145]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [169]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [193]  7  7  7  7  7  7  7  7  7  7  7  1  1  1  1  1  1  1  1  1  1  1  1  9
##  [217]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [241]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [265]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [289]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  7  7  7  7  7  7  7
##  [313]  7  7  7  7  1  1  1  1  1  1  1  1  1  1  1  1  9  9  9  9  9  9  9  9
##  [337]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [361]  9  9  9  9  9  9  9  9  9  9  9  9  7  7  7  7  7  7  7  7  7  7  1  1
##  [385]  1  1  1  1  1  1  1  1  1  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [409]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [433]  9  9  7  7  7  7  7  7  7  7  7  7  7  1  1  1  1  1  1  1  1  1  1  1
##  [457]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [481]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  7  7  7  7  7  7  7  1
##  [505]  1  1  1  1  1  1  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [529]  9  9  9  9  9  9  9  9  9  9  7  7  7  7  7  7  1  1  1  1  1  1  1  9
##  [553]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  7  7
##  [577]  7  7  7  7  7  7  1  1  1  1  1  1  1  1  1  9  9  9  9  9  9  9  9  9
##  [601]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  7  7  7
##  [625]  7  7  7  7  1  1  1  1  1  1  1  1  9  9  9  9  9  9  9  9  9  9  9  9
##  [649]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  7  7  7  7  7  7  7
##  [673]  1  1  1  1  1  1  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [697]  9  9  9  9  9  9  9  9  9  9  9  7  7  7  7  7  7  7  7  7  1  1  1  1
##  [721]  1  1  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [745]  9  9  9  9  9  9  9  9 10 10 10 10 10 10 10 10 10 10 10 10  4  4  4  4
##  [769]  4  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [793]  9  9  9  9 10 10 10 10 10 10 10 10 10 10 10 10  4  4  4  4  4  9  9  9
##  [817]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [841]  9 10 10 10 10 10 10 10 10 10 10 10 10  4  4  4  4  4  9  9  9  9  9  9
##  [865]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9 10
##  [889] 10 10 10 10 10 10 10 10 10 10 10  4  4  4  4  4  4  4  4  9  9  9  9  9
##  [913]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [937]  9  9  9  9  9  9 10 10 10 10 10 10 10 10 10 10 10 10 10 10  4  4  4  4
##  [961]  4  4  4  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
##  [985]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9 10 10 10 10
## [1009] 10 10 10 10 10 10 10  4  4  4  4  4  4  4  4  9  9  9  9  9  9  9  9  9
## [1033]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
## [1057]  9  9  9  9  9 10 10 10 10 10 10 10 10 10 10 10 10  4  4  4  4  4  4  4
## [1081]  4  4  4  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
## [1105]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9 10 10 10 10 10 10
## [1129] 10 10 10 10 10  4  4  4  4  4  4  4  4  4  9  9  9  9  9  9  9  9  9  9
## [1153]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
```

```
## [1177]  9  9  9  9  9 10 10 10 10 10 10 10 10 10 10 10  4  4  4  4  4  4  4  4
## [1201]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
## [1225]  9  9  9  9  9  9  9  9  9  9  9  9  9 10 10 10 10 10 10 10 10 10 10 10
## [1249] 10  4  4  4  4  4  4  4  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
## [1273]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9 10 10 10 10 10 10
## [1297] 10 10 10 10 10 10  4  4  4  4  4  4  4  4  4  4  4  9  9  9  9  9  9  9
## [1321]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
## [1345]  9  9  9  9  9  9  9  9  9  9  9  9  9 10 10 10 10 10 10 10 10 10 10 10
## [1369] 10  4  4  4  4  4  4  4  4  4  4  4  4  9  9  9  9  9  9  9  9  9  9  9
## [1393]  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9  9
## [1417]  9  9  9  9  9  9  9  9  9 10  3  3  3  3  3  3  3  3  3  3  3  3  3  3
## [1441]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3
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## [1753]  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3  3 11  2 11 11 11 11 11 11
## [1777] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  2  2  2 11 11 11 11 11 11
## [1801] 11 11 11 11 11 11 11 11 11 11 11  2  2  2  2  2  2 11 11 11 11 11 11 11
## [1825] 11 11 11 11 11 11 11 11 11 11 11 11 12 12 12 12 12 12  2  2  2  2  2  2
## [1849] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5  5
## [1873]  5 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11
## [1897] 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5 12 12 12 12 12 12 12 12 12
## [1921]  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [1945] 11 11 11 11  5  5 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2
## [1969]  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [1993]  5  5  5  5  5 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2  2
## [2017]  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5
## [2041]  5  5 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2
## [2065]  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2089]  5  5  5 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2
## [2113]  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2137] 11 11 11 11  5 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [2161]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11
## [2185] 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5 12 12 12 12 12 12 12 12 12
## [2209] 12 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2233]  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2257] 11  5  5  5  5  8  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [2281] 12 12  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11
## [2305] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5  5
## [2329]  8  8  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2
## [2353]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11
## [2377] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5  8
## [2401]  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2
## [2425]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11
## [2449] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5
```
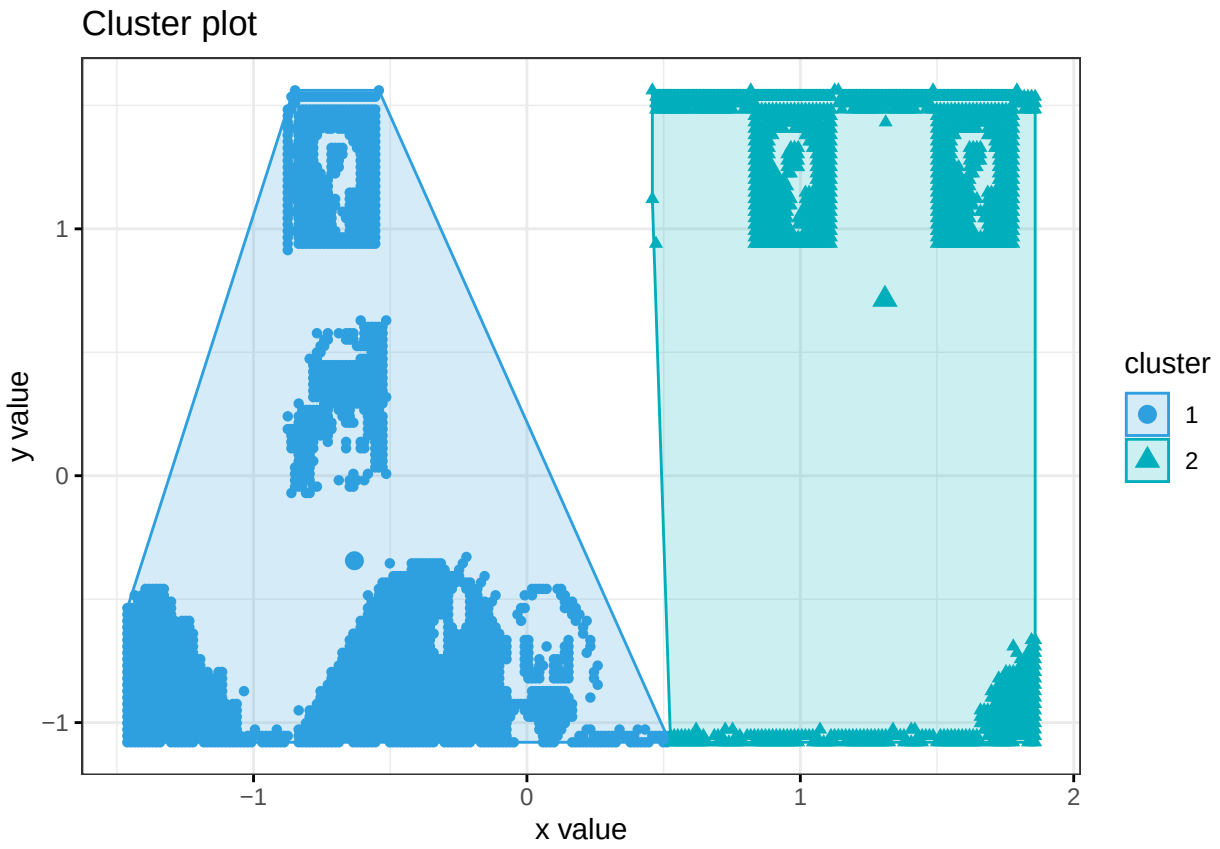
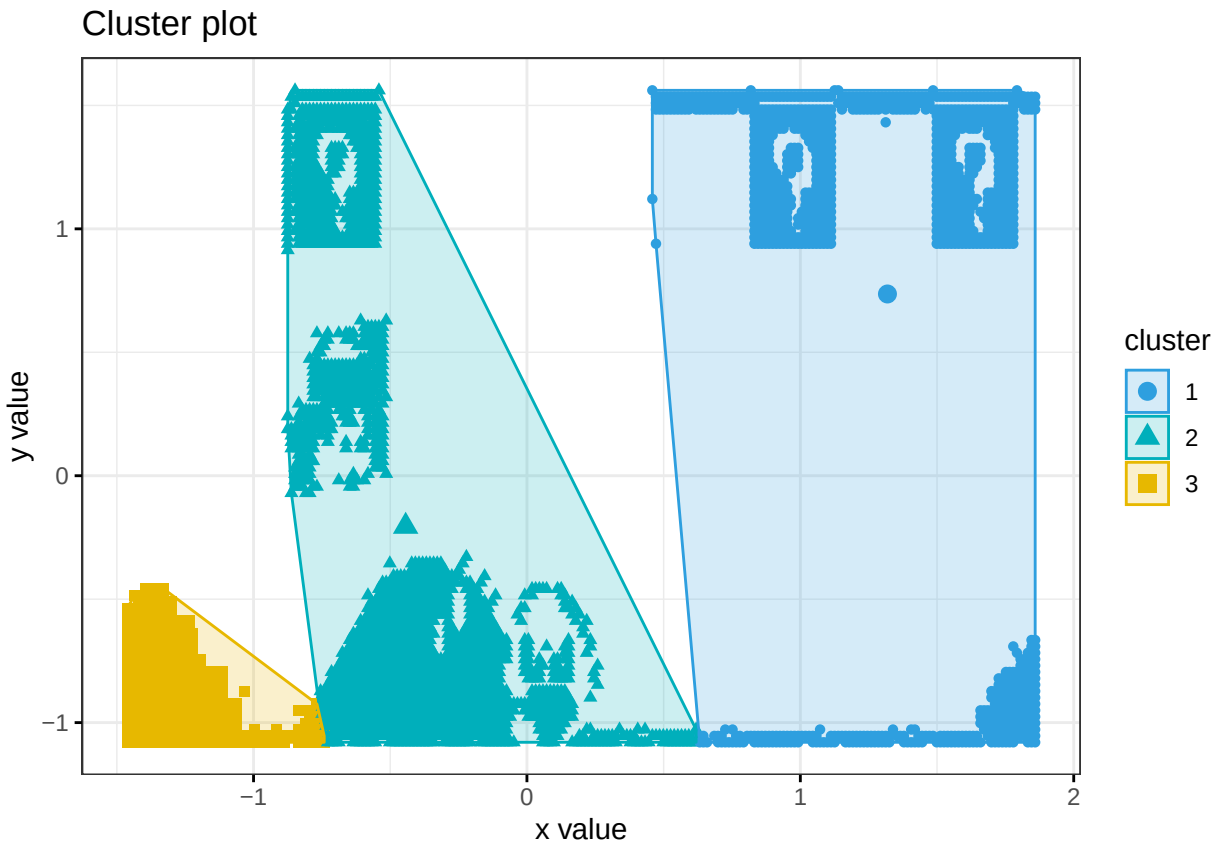

```
## [2473]  5  5  5  5  8  8  8  8  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [2497] 12 12 12 12 12 12  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2521]  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2545] 11 11 11  5  5  5  5  5  5  5  5  8  8  8  8  8 12 12 12 12 12 12 12 12 12
## [2569] 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2
## [2593]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11
## [2617] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5  5  5  5  5
## [2641]  5  5  8  8  8  8  8  8  8  8  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [2665] 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2  2  2  2
## [2689]  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2713] 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5  5  5  5  5  5  5  8  8
## [2737]  8  8  8  8  8  8  8  8  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [2761] 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2785]  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2809] 11 11 11 11 11 11 11 11 11 11 11 11  5  8  8  8  8  8  8  8  8  8  8  8 12
## [2833] 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [2857] 12 12 12  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2881]  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [2905] 11 11 11 11 11 11  5  5  5  5  5  5  5  5  5  5  5  5  8  8  8  8  8  8  8
## [2929]  8  8  8  8  8  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [2953] 12 12 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [2977]  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [3001] 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5  5  5  5  5  5  5  5  5
## [3025]  5  8  8  8  8  8  8  8  8  8  8  8  8  8 12 12 12 12 12 12 12 12 12 12 12
## [3049] 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2
## [3073]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11
## [3097] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5
## [3121]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  8  8  8  8  8
## [3145]  8  8  8  8  8  8  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [3169] 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2  2  2
## [3193]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11
## [3217] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5
## [3241]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  8  8  8  8  8  8  8  8  8  8  8
## [3265]  8  8  8  8  8  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [3289] 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2  2  2  2
## [3313]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11
## [3337] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5  5
## [3361]  5  5  5  5  5  5  5  5  5  5  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [3385]  8  8 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [3409] 12 12 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3433]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11
## [3457] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5  5  5  5  5
## [3481]  5  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8 12 12 12 12 12 12 12 12
## [3505] 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [3529] 12  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3553]  2  2  2  2  2  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
## [3577] 11 11 11 11 11 11 11 11 11 11 11  5  5  5  5  5  5  5  5  5  5  5  5  5  5
## [3601]  6  6  6  6  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8 12 12
## [3625] 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12
## [3649] 12 12 12 12 12 12 12 12 12 12 12 12  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3673]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2 11
## [3697] 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5
## [3721]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  6
## [3745]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
```

```
## [3769]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
## [3793]  6  6  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [3817]  8  8  8  8  8  8  8  8  8  8  8  8 12 12 12 12 12 12 12 12 12 12 12
## [3841] 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12  2  2
## [3865]  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2  2
## [3889]  2  2  2  2  2 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11  5
## [3913]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
## [3937]  5  5  5  5  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
## [3961]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
## [3985]  6  6  6  6  6  6  6  6  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
## [4009]  8  8  8  8  8  8  8  8  8  8  8  8  8  8
##
## Within cluster sum of squares by cluster:
##  [1]   2502.190  60236.338  35774.686   1735.263  32322.910  35016.523
##  [7]   2441.188  24436.867 831375.777   3607.079  73385.700  67391.591
##  (between_SS / total_SS =  95.9 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

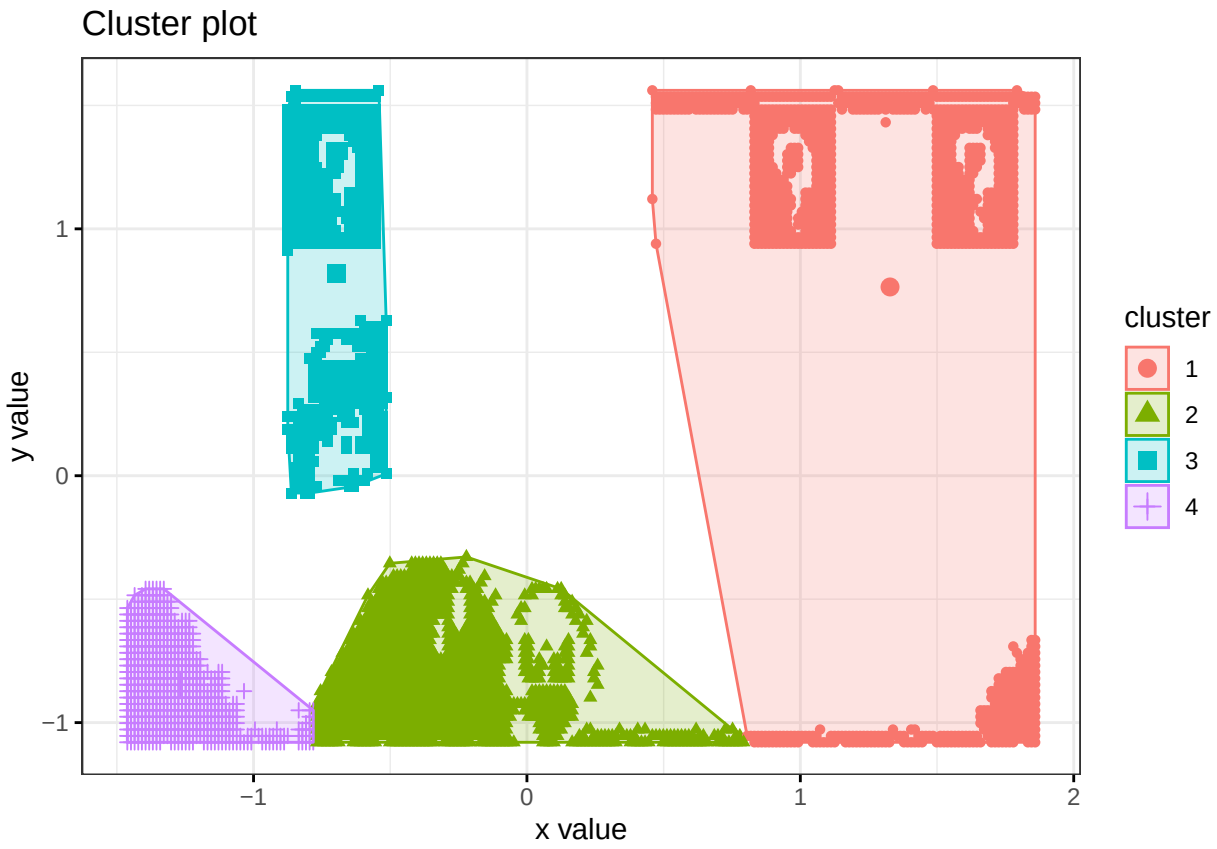
```
## fviz_cluster

fviz_cluster(cluster2, data= datasetcluster_df[, -100],
             palette = c("#2E9FDF", "#00AFBB", "#E7B800"),
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```



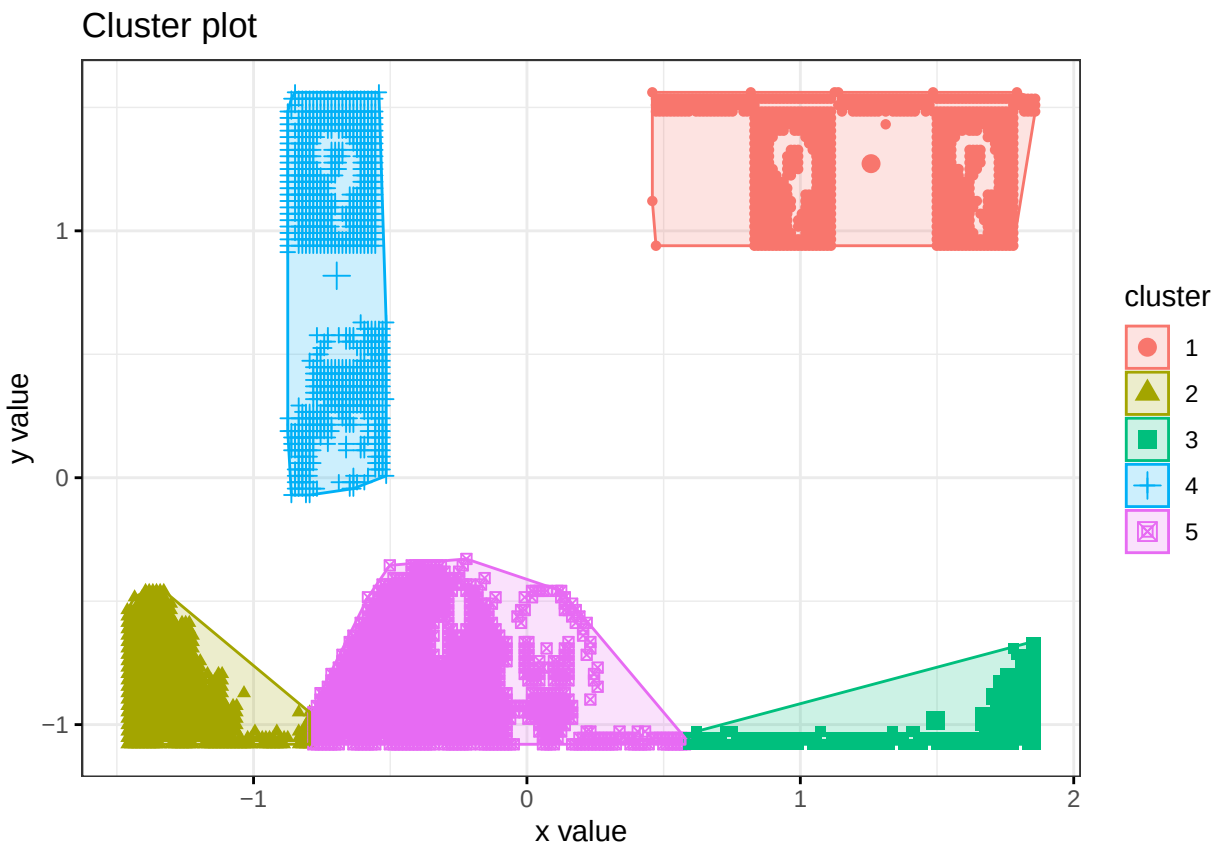

```
fviz_cluster(cluster3, data= datasetcluster_df[, -100],
             palette = c("#2E9FDF", "#00AFBB", "#E7B800"),
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```



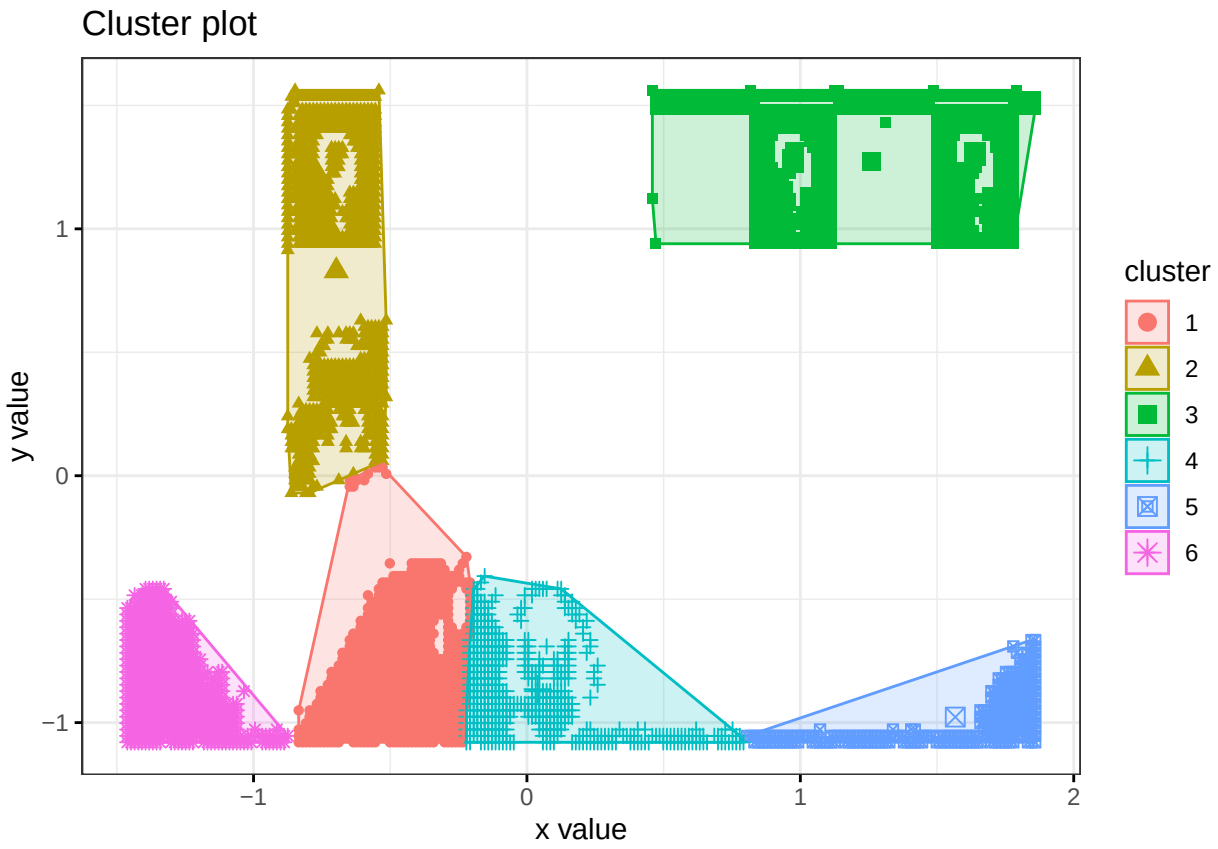

```
fviz_cluster(cluster4, data= datasetcluster_df[, -100],
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```



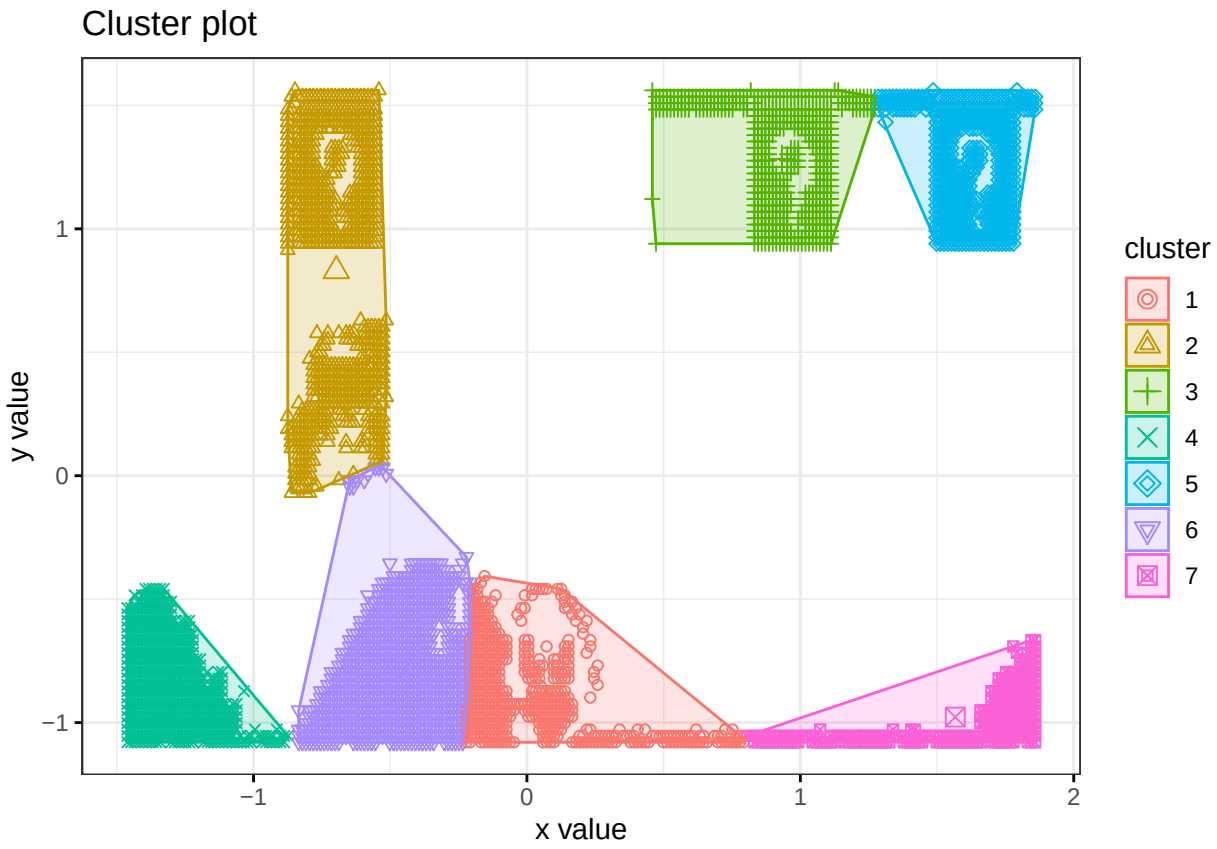

```
fviz_cluster(cluster5, data= datasetcluster_df[, -100],
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```



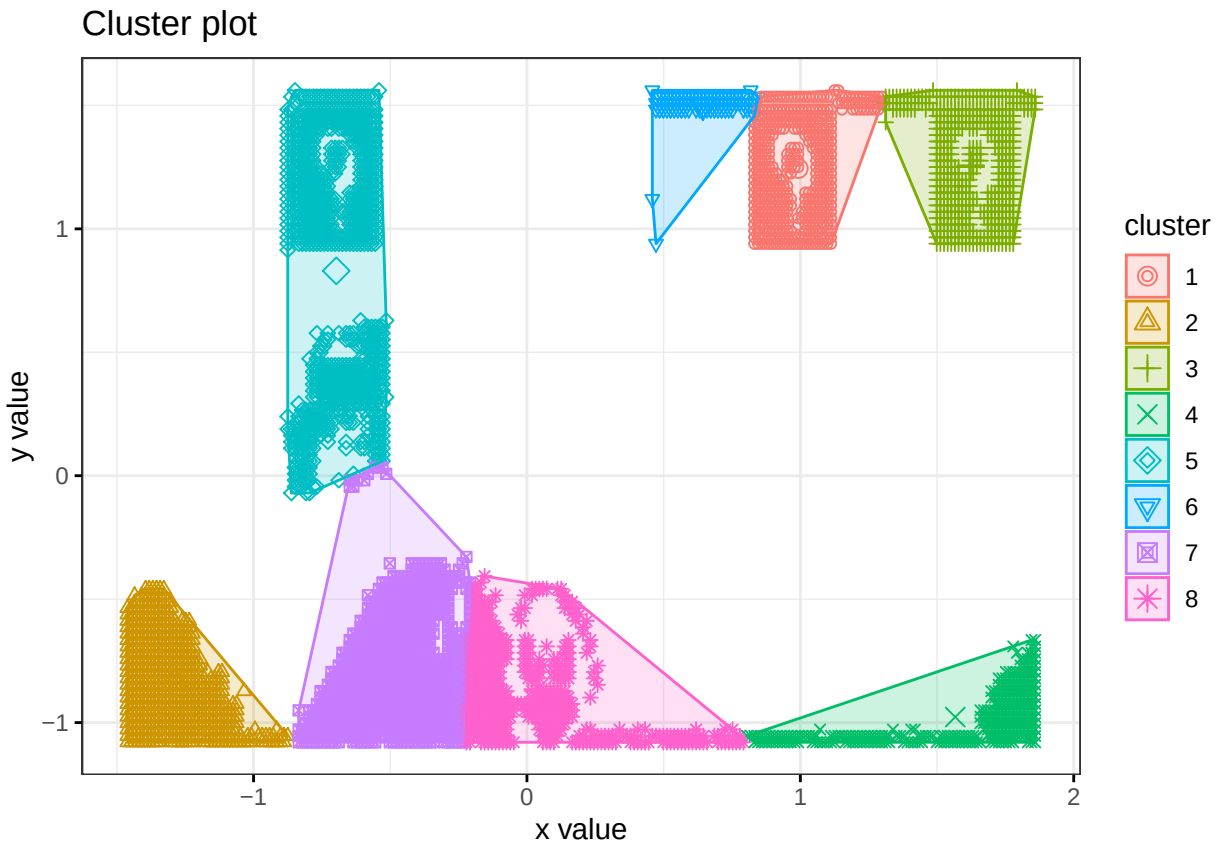

```
fviz_cluster(cluster6, data= datasetcluster_df[, -100],
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```



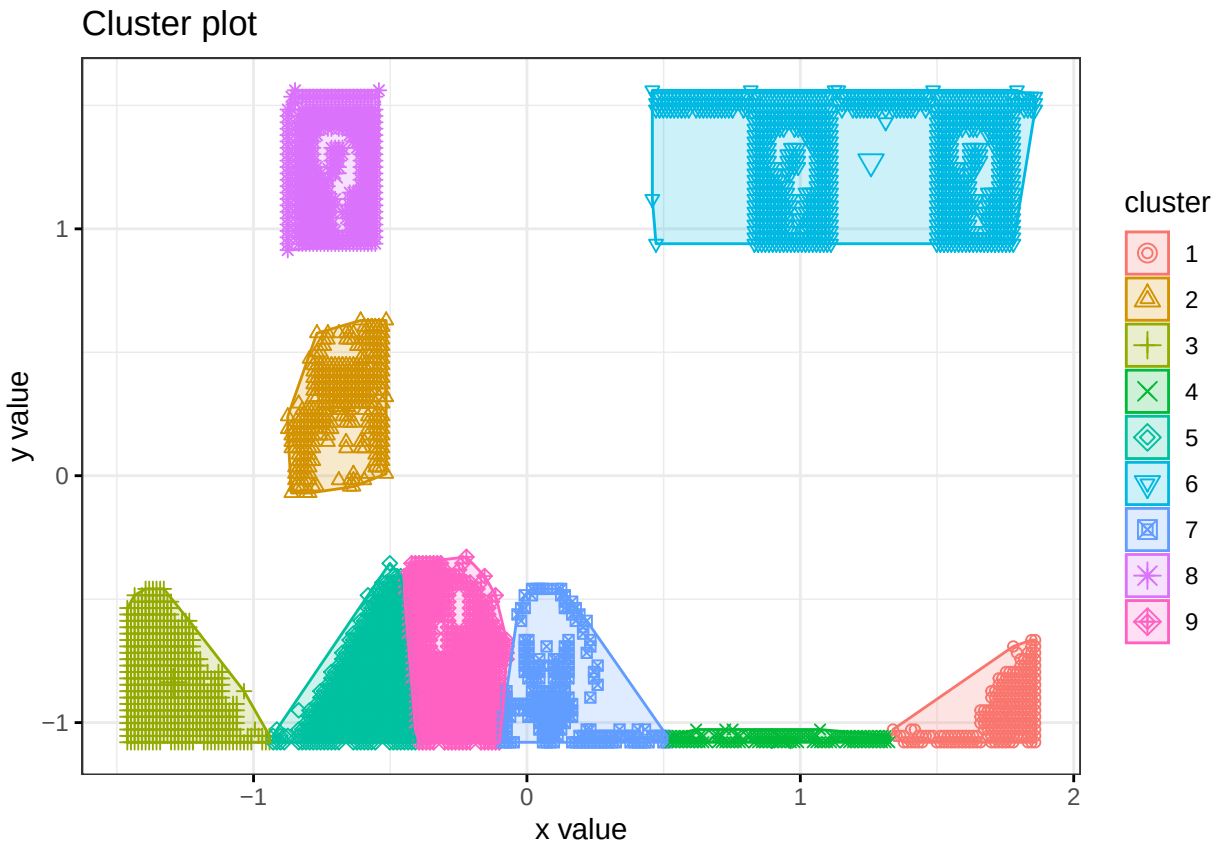

```
fviz_cluster(cluster7, data= datasetcluster_df[, -100],
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```



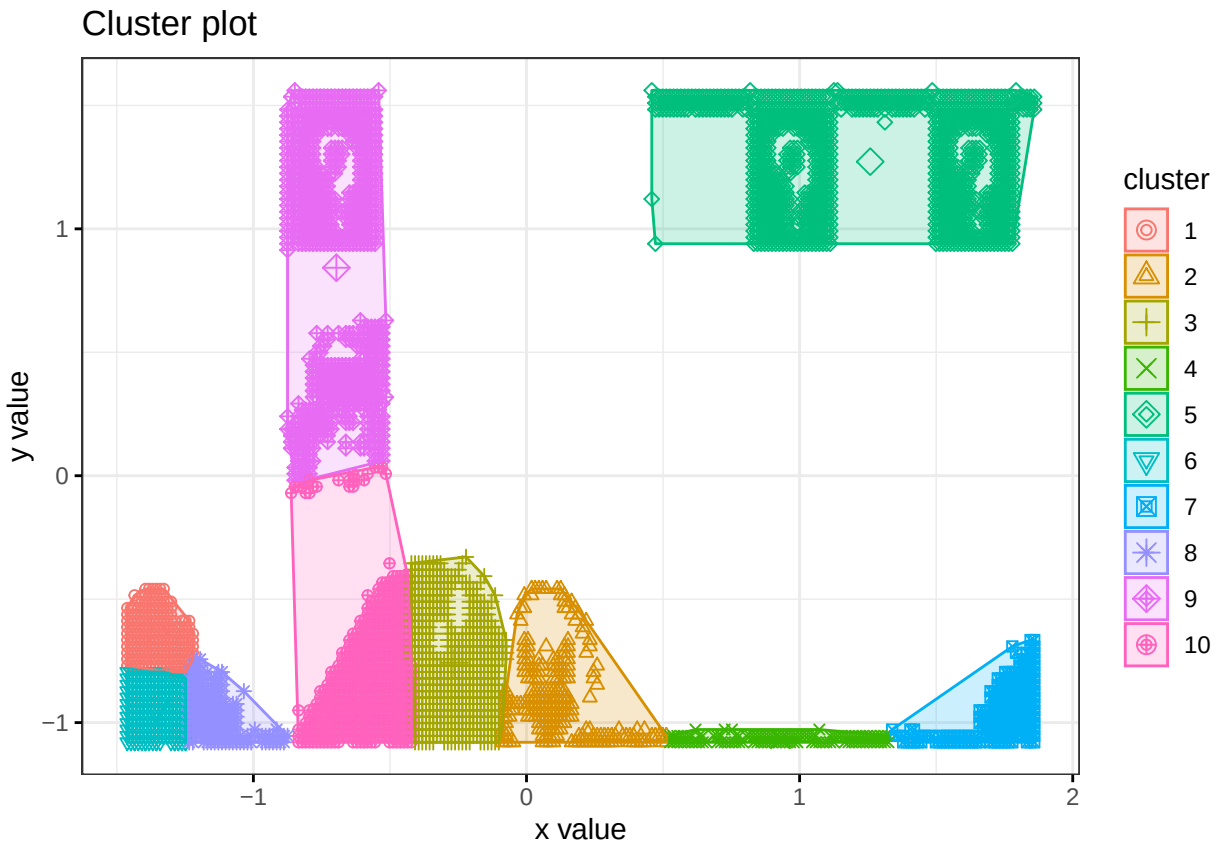

```
fviz_cluster(cluster8, data= datasetcluster_df[, -100],
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```



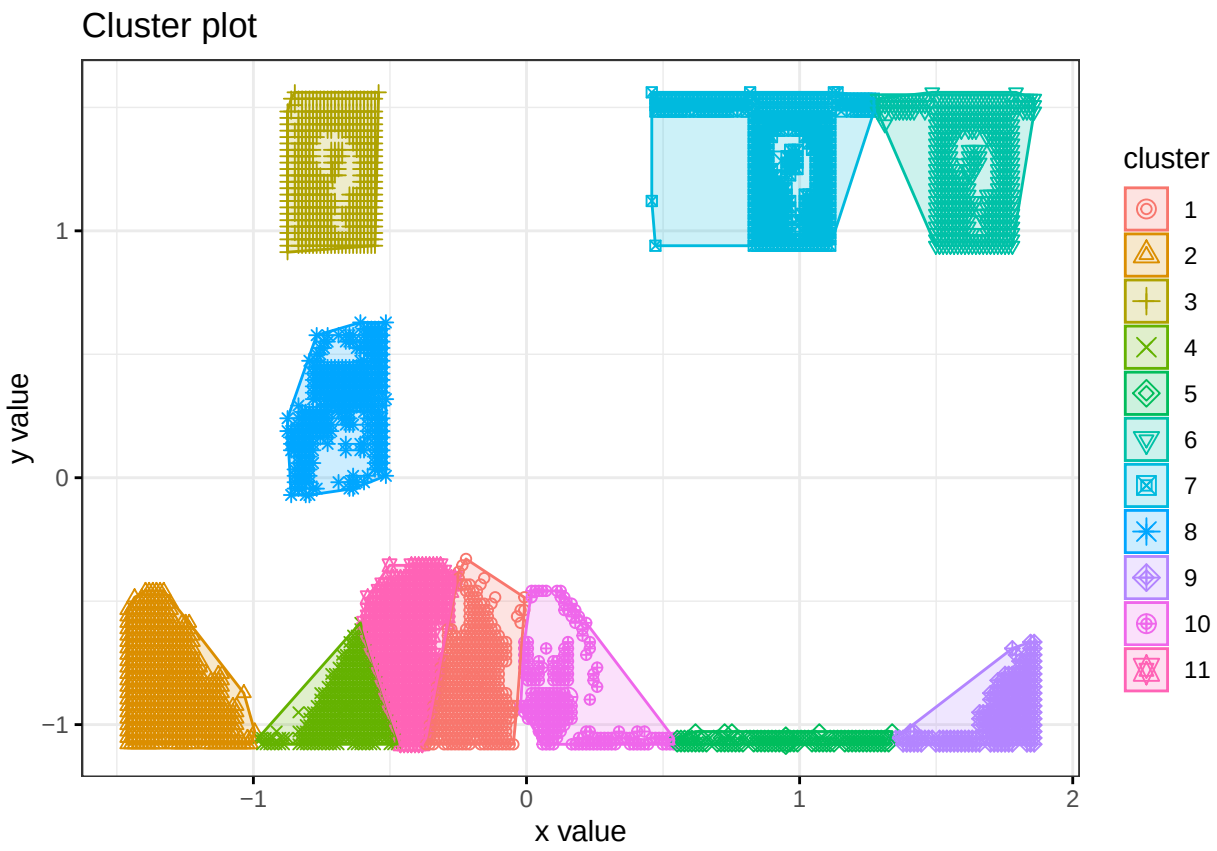

```
fviz_cluster(cluster9, data= datasetcluster_df[, -100],
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```



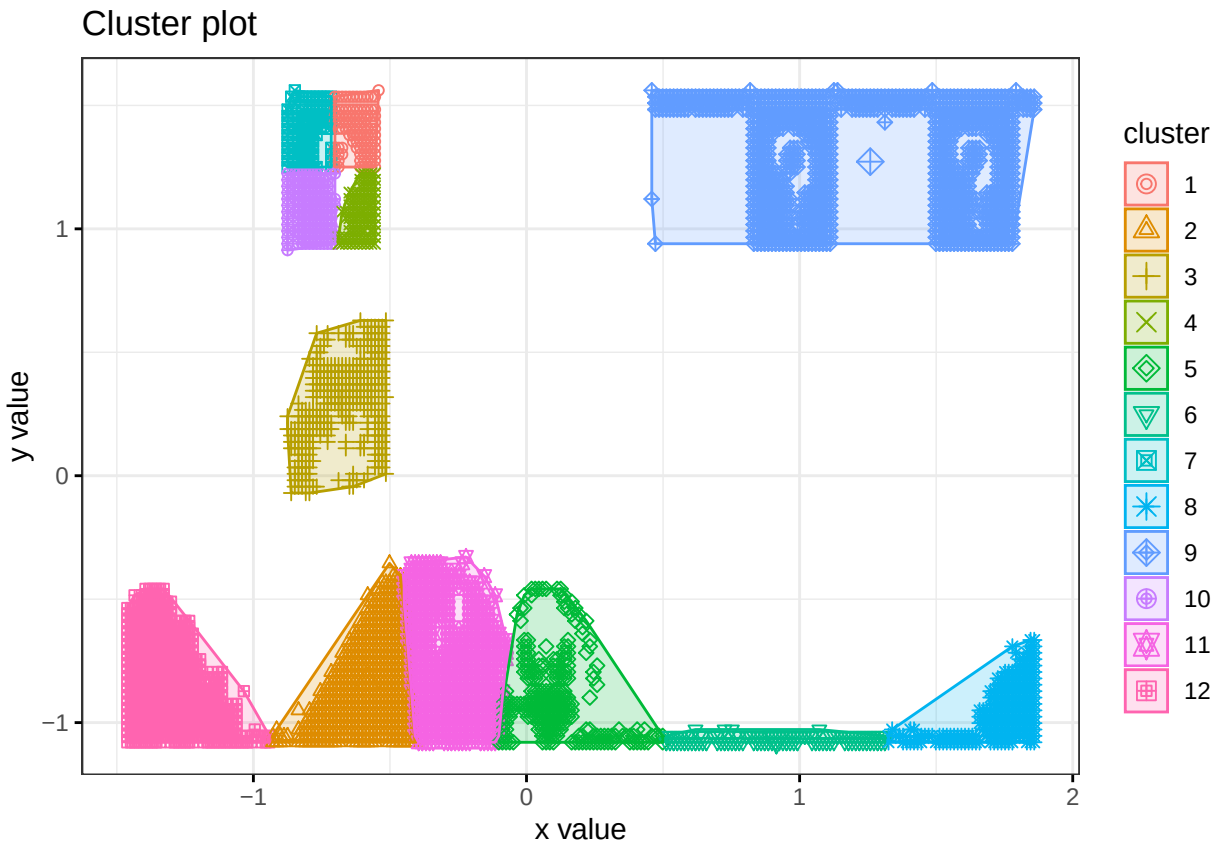

```
fviz_cluster(cluster10, data= datasetcluster_df[, -100],
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```




```
fviz_cluster(cluster11, data= datasetcluster_df[, -100],
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```




```
fviz_cluster(cluster12, data= datasetcluster_df[, -100],
             geom = "point",
             ellipse.type = "convex",
             ggtheme = theme_bw())
```




**C. As k-means is an unsupervised algorithm, you cannot compute the accuracy as there are no correct values to compare the output to. Instead,**

**you will use the average distance from the center of each cluster as a measure of how well the model fits the data. To calculate this metric,**

**simply compute the distance of each data point to the center of the cluster it is assigned to and take the average value of all of those distances.**

```
distance2<-distance(cluster2$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 2 vectors.
```

```
distance2
```

```
## euclidean
##  151.1523
```

```
distance3<-distance(cluster3$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 3 vectors.
```

```
distance3
```

```
##          v1        v2        v3
## v1   0.0000 137.06041 202.68484
## v2 137.0604   0.00000  65.94272
## v3 202.6848  65.94272   0.00000
```

```
distance4<-distance(cluster4$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 4 vectors.
```

```
distance4
```

```
##          v1        v2        v3        v4
## v1   0.0000 135.44096 151.78432 204.43178
## v2 135.4410   0.00000  69.87657  73.65898
## v3 151.7843  69.87657   0.00000  77.35550
## v4 204.4318  73.65898  77.35550   0.00000
```

```
distance5<-distance(cluster5$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 5 vectors.
```

```
distance5
```

```
##           v1        v2        v3        v4        v5
## v1   0.00000 206.75345  88.93857 147.60409 142.17903
## v2 206.75345   0.00000 207.58334  77.50881  72.46763
## v3  88.93857 207.58334   0.00000 178.34938 135.24745
## v4 147.60409  77.50881 178.34938   0.00000  69.06147
## v5 142.17903  72.46763 135.24745  69.06147   0.00000
```

```
distance6<-distance(cluster6$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 6 vectors.
```

```
distance6
```

```
##           v1        v2        v3        v4        v5        v6
## v1   0.00000  64.20602 151.86600  38.41595 152.99891  61.27086
## v2  64.20602   0.00000 147.66212  85.63776 183.56123  78.22516
## v3 151.86600 147.66212   0.00000 123.18258  89.91041 207.61918
## v4  38.41595  85.63776 123.18258   0.00000 114.62485  99.47405
## v5 152.99891 183.56123  89.91041 114.62485   0.00000 214.07714
## v6  61.27086  78.22516 207.61918  99.47405 214.07714   0.00000
```

```
distance7<-distance(cluster7$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 7 vectors.
```

```
distance7
```

```
##           v1        v2        v3        v4        v5        v6        v7
## v1   0.00000  85.63776 106.64207  99.47405 144.18000  38.41595 114.62485
## v2  85.63776   0.00000 123.48264  78.22516 174.56686  64.20602 183.56123
## v3 106.64207 123.48264   0.00000 185.58640  51.54757 131.86874  99.41820
## v4  99.47405  78.22516 185.58640   0.00000 232.62119  61.27086 214.07714
## v5 144.18000 174.56686  51.54757 232.62119   0.00000 175.36875  86.51339
## v6  38.41595  64.20602 131.86874  61.27086 175.36875   0.00000 152.99891
## v7 114.62485 183.56123  99.41820 214.07714  86.51339 152.99891   0.00000
```

```
distance8<-distance(cluster8$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 8 vectors.
```

```
distance8
```

```
##           v1        v2        v3        v4        v5        v6        v7
## v1   0.00000 188.95086  47.35289  96.02431 127.69927  27.94801 134.57937
## v2 188.95086   0.00000 232.83459 214.07714  78.22516 170.68144  61.27086
## v3  47.35289 232.83459   0.00000  86.41990 174.82278  74.09473 175.56015
## v4  96.02431 214.07714  86.41990   0.00000 183.56123 118.09989 152.99891
## v5 127.69927  78.22516 174.82278 183.56123   0.00000 103.81775  64.20602
## v6  27.94801 170.68144  74.09473 118.09989 103.81775   0.00000 121.20981
## v7 134.57937  61.27086 175.56015 152.99891  64.20602 121.20981   0.00000
## v8 108.36619  99.47405 144.33935 114.62485  85.63776 101.94947  38.41595
##           v8
## v1 108.36619
## v2  99.47405
## v3 144.33935
## v4 114.62485
## v5  85.63776
## v6 101.94947
## v7  38.41595
## v8   0.00000
```

```
distance9<-distance(cluster9$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 9 vectors.
```

```
distance9
```

```
##           v1        v2        v3        v4        v5        v6        v7
## v1   0.00000 186.71349 226.71747  60.10161 173.53092  92.75594 120.68118
## v2 186.71349   0.00000  63.53558 131.43838  44.09338 150.01441  75.16694
## v3 226.71747  63.53558   0.00000 166.97819  53.20075 207.98944 106.03634
## v4  60.10161 131.43838 166.97819   0.00000 113.89154  93.58851  61.11574
## v5 173.53092  44.09338  53.20075 113.89154   0.00000 160.36609  52.85580
## v6  92.75594 150.01441 207.98944  93.58851 160.36609   0.00000 119.33452
## v7 120.68118  75.16694 106.03634  61.11574  52.85580 119.33452   0.00000
## v8 201.28604  36.12113  90.85300 151.51878  80.13358 147.65236 102.63392
## v9 150.07058  50.54412  76.87572  90.76466  23.83080 138.65837  29.69298
##           v8        v9
## v1 201.28604 150.07058
## v2  36.12113  50.54412
## v3  90.85300  76.87572
## v4 151.51878  90.76466
## v5  80.13358  23.83080
## v6 147.65236 138.65837
## v7 102.63392  29.69298
## v8   0.00000  83.13482
## v9  83.13482   0.00000
```

```
distance10<-distance(cluster10$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 10 vectors.
```

```
distance10
```

```
##           v1        v2        v3        v4        v5        v6        v7
## v1    0.00000 110.78876  81.56189 171.75654 209.14323  11.46448 231.21443
## v2  110.78876   0.00000  29.37351  60.98459 119.21337 110.97879 120.54598
## v3   81.56189  29.37351   0.00000  90.32648 138.48693  82.31463 149.65304
## v4  171.75654  60.98459  90.32648   0.00000  93.58851 171.61718  60.10161
## v5  209.14323 119.21337 138.48693  93.58851   0.00000 213.98283  92.75594
## v6   11.46448 110.97879  82.31463 171.61718 213.98283   0.00000 231.48114
## v7  231.21443 120.54598 149.65304  60.10161  92.75594 231.48114   0.00000
## v8   20.55292  93.95859  65.44323 154.55496 198.83130  17.06622 214.43557
## v9   75.49987  90.67613  69.77051 142.48227 147.51180  84.86390 194.58912
## v10  58.12769  52.67048  23.62261 113.62902 159.11841  58.71021 173.16905
##           v8        v9       v10
## v1   20.55292  75.49987  58.12769
## v2   93.95859  90.67613  52.67048
## v3   65.44323  69.77051  23.62261
## v4  154.55496 142.48227 113.62902
## v5  198.83130 147.51180 159.11841
## v6   17.06622  84.86390  58.71021
## v7  214.43557 194.58912 173.16905
## v8    0.00000  76.91907  41.90640
## v9   76.91907   0.00000  63.64930
## v10  41.90640  63.64930   0.00000
```

```
distance11<- distance(cluster11$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 11 vectors.
```

```
distance11
```

```
##            v1        v2        v3        v4        v5        v6        v7
## v1    0.00000  82.61892  88.11353  35.00553  86.38083 158.23077 117.48037
## v2   82.61892   0.00000  90.90879  47.96090 168.74149 233.26495 186.17591
## v3   88.11353  90.90879   0.00000  83.18206 152.68333 174.75048 123.22603
## v4   35.00553  47.96090  83.18206   0.00000 120.79629 190.68757 146.78946
## v5   86.38083 168.74149 152.68333 120.79629   0.00000 102.92469  90.70769
## v6  158.23077 233.26495 174.75048 190.68757 102.92469   0.00000  51.54757
## v7  117.48037 186.17591 123.22603 146.78946  90.70769  51.54757   0.00000
## v8   56.27962  63.69088  36.12113  47.07835 132.75651 176.27317 126.64817
## v9  144.58879 227.17324 201.40391 179.30472  58.79853  85.69538 104.94304
## v10  26.16944 108.69851 104.10480  60.86877  60.21591 137.87508 102.29732
## v11  18.51125  65.32407  76.36644  19.74201 104.55142 170.97662 127.18164
##            v8        v9       v10       v11
## v1   56.27962 144.58879  26.16944  18.51125
## v2   63.69088 227.17324 108.69851  65.32407
## v3   36.12113 201.40391 104.10480  76.36644
## v4   47.07835 179.30472  60.86877  19.74201
## v5  132.75651  58.79853  60.21591 104.55142
## v6  176.27317  85.69538 137.87508 170.97662
## v7  126.64817 104.94304 102.29732 127.18164
## v8    0.00000 186.84150  77.06813  41.71882
## v9  186.84150   0.00000 118.47474 162.43195
## v10  77.06813 118.47474   0.00000  44.40133
## v11  41.71882 162.43195  44.40133   0.00000
```

```
distance12<- distance(cluster12$centers, method = "euclidean")
```

```
## Metric: 'euclidean'; comparing: 12 vectors.
```

```
distance12
```

```
##            v1        v2        v3        v4        v5        v6        v7
## v1    0.00000  86.40912  43.03265  13.07769 104.09187 149.39299  13.33243
## v2   86.40912   0.00000  44.09483  73.35383  52.48716 112.84309  87.69239
## v3   43.03265  44.09483   0.00000  30.27049  74.79668 130.39363  43.62676
## v4   13.07769  73.35383  30.27049   0.00000  92.64335 140.54980  19.35135
## v5  104.09187  52.48716  74.79668  92.64335   0.00000  60.43885 111.60867
## v6  149.39299 112.84309 130.39363 140.54980  60.43885   0.00000 159.80839
## v7   13.33243  87.69239  43.62676  19.35135 111.60867 159.80839   0.00000
## v8  197.92963 173.34352 186.45572 191.29884 120.86197  60.95844 209.80657
## v9  140.94925 160.45142 150.01441 139.99765 119.65464  93.89503 154.26911
## v10  17.60869  75.47033  31.47867  13.59190 101.60974 152.10187  12.31422
## v11  87.04097  23.78640  50.42956  74.33702  29.38692  89.78044  91.80618
## v12 100.09650  53.11099  63.53558  89.71572 105.57858 165.83961  93.94996
##            v8        v9       v10       v11       v12
```

```
## v1  197.92963 140.94925  17.60869  87.04097 100.09650
## v2  173.34352 160.45142  75.47033  23.78640  53.11099
## v3  186.45572 150.01441  31.47867  50.42956  63.53558
## v4  191.29884 139.99765  13.59190  74.33702  89.71572
## v5  120.86197 119.65464 101.60974  29.38692 105.57858
## v6   60.95844  93.89503 152.10187  89.78044 165.83961
## v7  209.80657 154.26911  12.31422  91.80618  93.94996
## v8    0.00000  92.68932 204.01342 149.93882 226.44046
## v9   92.68932   0.00000 153.52438 138.75532 207.98944
## v10 204.01342 153.52438   0.00000  80.47614  83.19646
## v11 149.93882 138.75532  80.47614   0.00000  76.73554
## v12 226.44046 207.98944  83.19646  76.73554   0.00000
```

```
mean2<- mean(distance2)
mean2
```

```
## [1] 151.1523
```

```
mean3<- mean(distance3)
mean3
```

```
## [1] 90.15288
```

```
mean4<- mean(distance4)
mean4
```

```
## [1] 89.06851
```

```
mean5<- mean(distance5)
mean5
```

```
## [1] 106.0555
```

```
mean6<- mean(distance6)
mean6
```

```
## [1] 100.7073
```

```
mean7<- mean(distance7)
mean7
```

```
## [1] 106.2975
```

```
mean8<- mean(distance8)
mean8
```

```
## [1] 103.9763
```

```
mean9<- mean(distance9)
mean9
```

```
## [1] 96.63894
```

```
mean10<- mean(distance10)
mean10
```

```
## [1] 99.46185
```

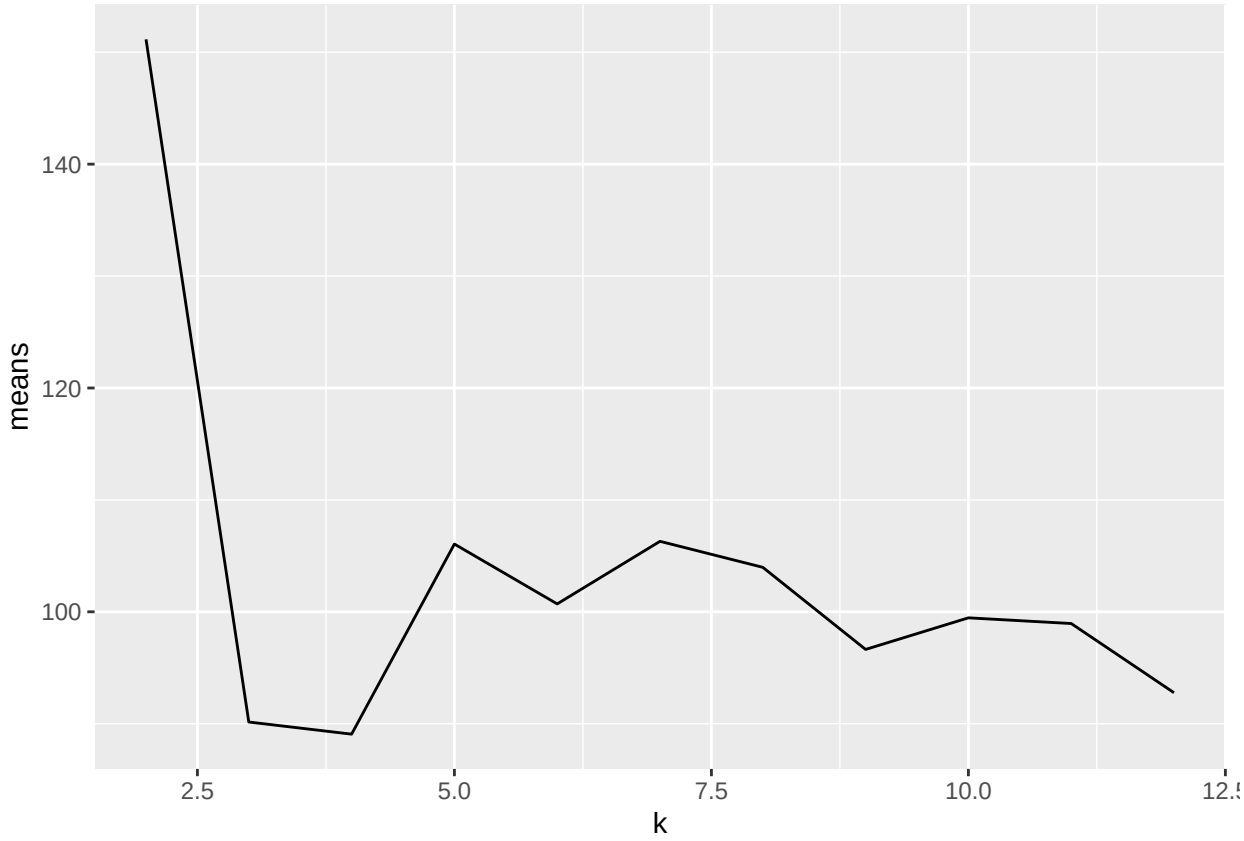
```
mean11<- mean(distance11)
mean11
```

```
## [1] 98.95458
```

```
mean12<- mean(distance12)
mean12
```

```
## [1] 92.77099
```

```
averagedf<- data.frame('k' = 2:12,
                       'means'= c(mean2,
                                  mean3,
                                  mean4,
                                  mean5,
                                  mean6,
                                  mean7,
                                  mean8,
                                  mean9,
                                  mean10,
                                  mean11,
                                  mean12))

ggplot(averagedf,aes(x=k, y=means)) +geom_line()
```




```
averagedf
```

```
##     k     means
## 1   2 151.15225
## 2   3  90.15288
## 3   4  89.06851
## 4   5 106.05546
## 5   6 100.70735
## 6   7 106.29746
## 7   8 103.97633
## 8   9  96.63894
## 9  10  99.46185
## 10 11  98.95458
## 11 12  92.77099
```

**Looking at the graph creating the elbow point would be where k=3 and the average distance is around 88.69. This is where the graph changes shape and has an inflection point.**